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NAWCAD Patuxent River, MD, is the Navy's principal air platform flight test and evaluation (T&E) activity. NAWCAD is actively engaged in the Navy's acquisition cycle for all phases of the aircraft system's life cycle, including support of technology demonstration and validation, engineering and manufacturing development (EMD), production and deployment, fleet operations, and fleet in-service engineering. Facilities and capabilities include a principal site for development T&E during EMD, as well as range facilities, flight and ground test support, technical and engineering support, and base support for Navy users, other DoD and government agencies, and commercial enterprises.

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Dynamic In-Flight Antenna Pattern Measurement Techniques

Prepared for SS-8/9 – "Electromagnetic Measurements and Associated Processing Techniques"

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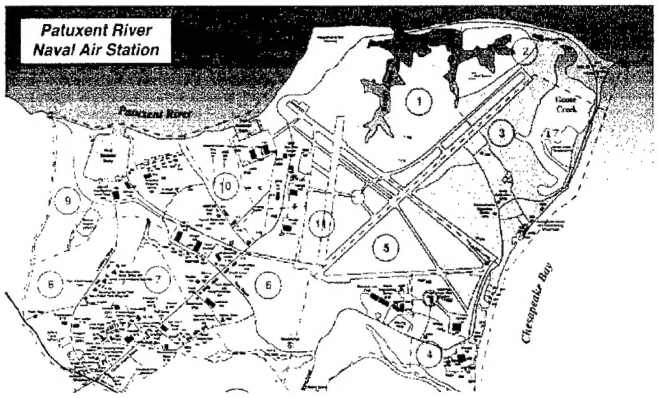
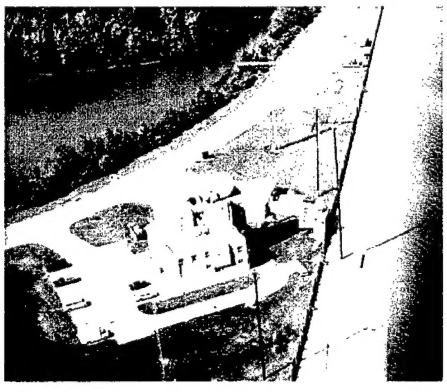
Patuxent River, MD

The Naval Air Warfare Center Aircraft Division (NAWCAD) Patuxent River, MD, is the Navy's principal air platform flight test and evaluation (T&E) activity. NAWCAD is actively engaged in the Navy's acquisition cycle for all phases of the aircraft system's life cycle, including support of technology demonstration and validation, engineering and manufacturing development (EMD), production and deployment, fleet operations, and fleet in-service engineering. Facilities and capabilities include a principal site for developmental T&E during EMD, as well as range facilities, flight and ground test support, technical and engineering support, and base support for Navy users, other DoD and government agencies, and commercial enterprises.



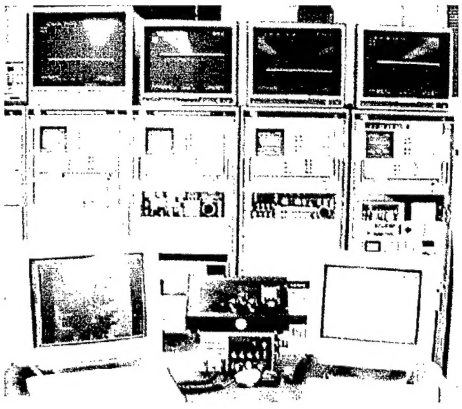
NAWCAD Patuxent River maintains and operates approximately 140 project test aircraft, comprising 44 types (fighter, attack, electronic warfare, ASW, trainer, strategic communications, etc.) of both fixed and rotary wing aircraft. The Patuxent River Complex is located about 70 miles south of the Pentagon in Washington, DC, and about 90 air miles from the fleet in Norfolk, VA. The air station is located on 7,950 acres adjacent to the Chesapeake Bay and 50,000 square miles of airspace for local air operations. The all-weather sea level airfield has three heavy capacity runways 6,400, 9,700, and 11,800 ft long. Over 1,000 buildings, including 10 double-bay hangars provide over 1.2 million square feet of space.

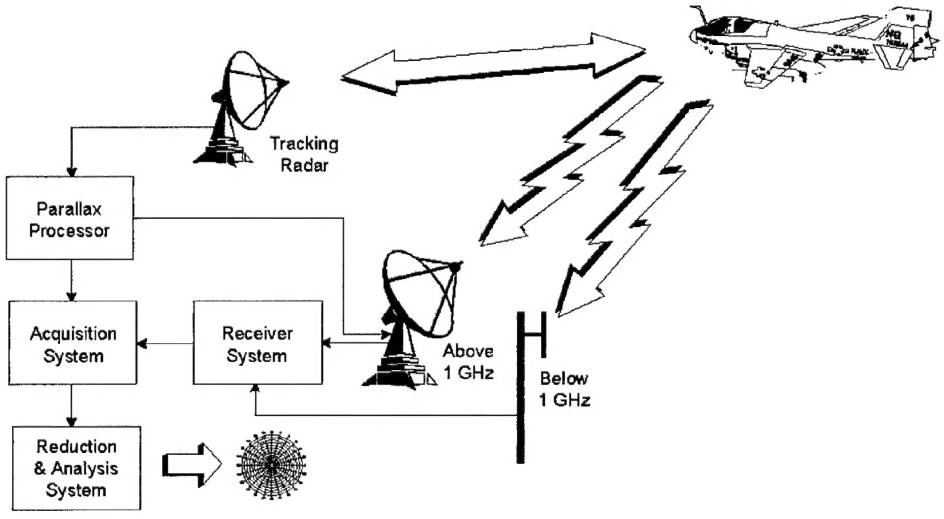


The Communications/Navigation/Identification and Antenna (CNIA) Systems Flight Test Facility provides the capability to conduct development support and test and evaluation on aircraft antennas, antenna installations, secure and non-secure analog and digital communication and data link systems, satellite communications systems, Identification Friend or Foe (IFF) systems, and navigation systems. The facility provides the capability for unobstructed testing in an overwater, smooth ground plane, low EMI test environment. The CNIA Flight Test

Facility houses the Antenna Testing Laboratory Automated System (ATLAS), the Communications Flight Test and Evaluation Laboratory (COMTEL), and the Navy IFF Test and Evaluation Laboratory (NIFFTE). The ATLAS provides dynamic in-flight antenna pattern measurement capability. The COMTEL provides unique airborne communications test capability for HF, VHF, UHF, plain and secure voice, satellite communications (DAMA and non-DAMA), SINCGARS, MIDS, JTIDS, Digital and Have-Quick communications. The NIFFTE provides automated and instrumented interrogator and transponder systems including the AN/APX-76, AN/APX-100, AN/APX-72, and TCAS.

Dynamic in-flight antenna pattern measurement are condcuted using the ATLAS test facility located in Building 1703 at NAWCAD Patuxent River. The ATLAS provides a unique capability to measure the in-flight antenna radiation patterns of airborne antennas to ensure reliable, functional antenna systems are installed in fleet aircraft. The ATLAS facility operates over the 2 MHz to 18 GHz frequency range. The ATLAS provides free-space antenna patterns referenced to isotropic (dBI) and/or Effective Radiated Power (ERP) patterns. The ATLAS facility is versatile and unique.

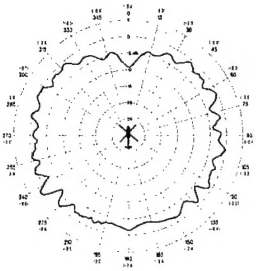


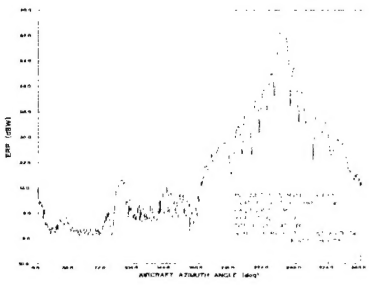


The ATLAS test facility provides the unique capability to measure antenna radiation and ERP patterns of airborne antennas, in-flight, with accuracy normally obtainable only under laboratory conditions. An extensive antenna farm is located adjacent to this facility which contains omnidirectional and directional antennas which have unobstructed electromagnetic propagation paths over the Chesapeake Bay. The ATLAS facility utilizes the Atlantic Test Range Facility for radar

tracking and aircraft controller support. The ATLAS facility utilizes a vertical whip and a horizontal loop for HF frequencies. Standard gain dipole and log-periodic antennas are utilized from 30 MHz to 1 GHz. Above 1 GHz, 10-, 6-, and 2-ft parabolic dish antennas are used.

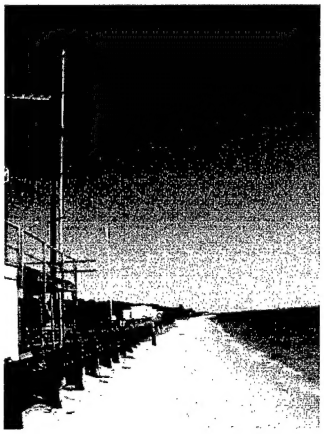
The ATLAS facility is highly adaptable and flexible. The ATLAS utilizes a variety of calibrated receive antennas, fully programmable receivers, and an automatic calibration system consisting of synthesized signal generators, highly accurate, calibrated power meters and programmable attenuators. The ATLAS system can simultaneously test multiple antennas and/or frequencies.

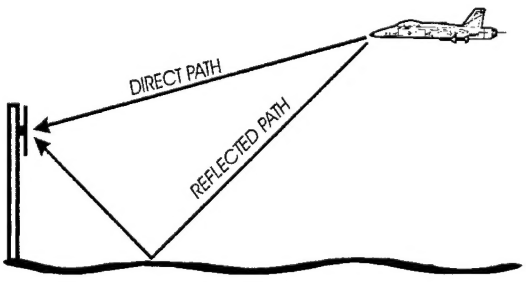


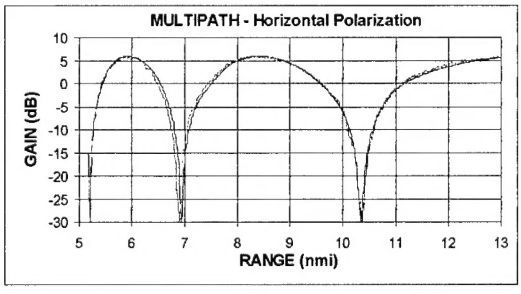


The ATLAS laboratory is also used as a specification range for aircraft antenna systems and is used for verification of data obtained at other DoD antenna ground ranges and contractor antenna test facilities. The antenna pattern results are used to determine specification compliance, mission suitability, and tactics development for operational users. The ATLAS facility is utilized by Navy, DoD, contractor, and other non-DoD government agencies.

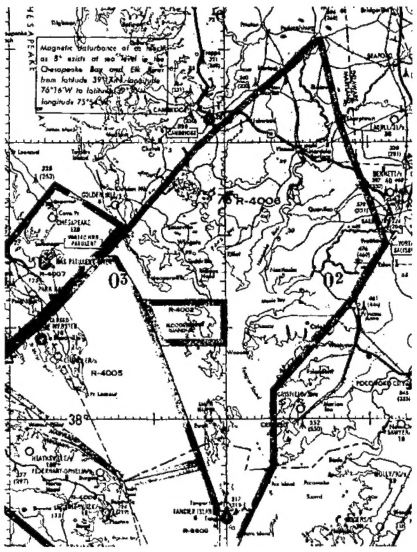
The ATLAS facility's capability to measure free-space in-flight antenna patterns and reference them to an isotropic source is unique. The location of the ATLAS facility on the Chesapeake Bay provides a calm body of water to serve as a reflection surface for RF energy. The calmness of the Bay allows accurate characterization of the reflecting electromagnetic energy. The multipath interference can be calculated based on the height of the aircraft, the height of the receive antenna, the frequency, range and polarization. The mathematical equations are developed and presented in the January 1984 issue of the *IEEE Transactions on Antennas and Propagations*. As a result, the measured antenna pattern can be corrected for multipath effects, to obtain true free-space antenna and ERP patterns.



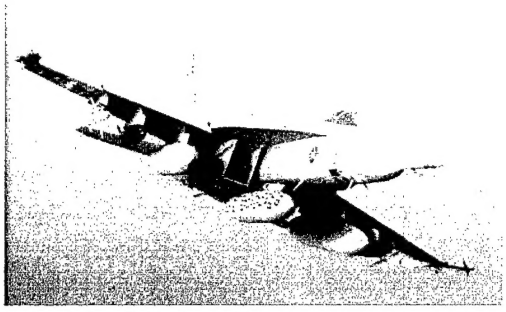




The location of the ATLAS facility also has the advantage of being conveniently located next to restricted airspaces. This allows the aircraft to operate in a positive-controlled environment while Patuxent Advisory provides the aircrew with traffic calls of adjacent aircraft.



The ATLAS started out in the 1950's using radio receivers, stripcharts and measuring tedious 24-point cloverleaf flight profiles. The facility has been continually updated with state-of-the-art test equipment and now utilizes a VME-based computer system which can take over 1,000 data samples-per-second on 10 channels simultaneously. Polar azimuth antenna patterns plots are the standard output format, but data is also available in rectangular and digital formats.



Recent antenna evaluations include: the KC-130, VP-3, and C-2 TCAS, the F/A-18E/F CNI, the E-2C SATCOM, the SH-60R CNI, the F-14D GPS, the V-22 CNI, the P-3C SATCOM, the E-2C ROTODOME, the CH-53D/CH-46E GPS, the EA-6B ALQ-99 JAMMER, the US ARMY APACHE HF, the USCG HH-60J COMM, the USAF C-130 JTIDS, and the FAA KING-AIR GPS antenna evaluations.

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